

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: John Deryk WATERS

Title: APPARATUS FOR PRINTING, DATA WRITING TO MEMORY
TAGS AND DATA READING FROM MEMORY TAGS, AND
METHODS THEREFOR

Appl. No.: Unassigned

Filing Date: 10/31/2002

Examiner: Unassigned

Art Unit: Unassigned

CLAIM FOR CONVENTION PRIORITY

Commissioner for Patents
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Sir:

The benefit of the filing date of the following prior foreign application filed in the following foreign country is hereby requested, and the right of priority provided in 35 U.S.C. § 119 is hereby claimed.

In support of this claim, filed herewith is a certified copy of said original foreign application:

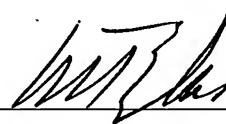
GREAT BRITAIN Patent Application No. 0227201.1
filed 11/21/2002.

Respectfully submitted,

Date: October 31, 2003

HEWLETT-PACKARD COMPANY
Intellectual Property Administration
P.O. Box 272400
Fort Collins, Colorado 80527-2400

By



William T. Ellis
Attorney for Applicant
Registration No. 26,874



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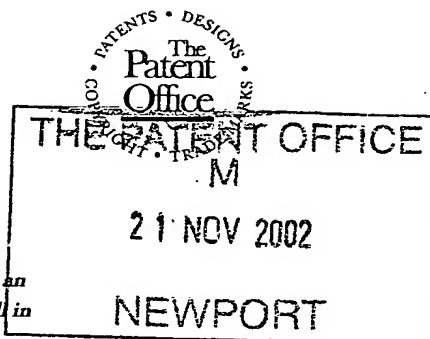
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1. Your reference 300203672-1 GB

2. Patent application number 21 NOV 2002 0227201.1
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3. Full name, address and postcode of the or of each applicant (underline all surnames) Hewlett-Packard Company
3000 Hanover Street
Palo Alto
CA 94304, USA

00496588001

Patents ADP number (if you know it)

Delaware, USA

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention Apparatus for Printing, Data Writing to
Memory Tags and Data Reading from Memory
Tags, and Methods Therefor

5. Name of your agent (if you have one) Richard A. Lawrence
Hewlett-Packard Ltd, IP Section
Filton Road, Stoke Gifford
Bristol BS34 8QZ
"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

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07448038001

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		(if you know it)	(day / month / year)

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11 ✓

Claim(s)

4 ✓

Abstract

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Richard A. Lawrence

Date

20/11/02

12. Name and daytime telephone number of person to contact in the United Kingdom

Meg Joyce Tel: 0117-312-9068

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Title: Apparatus for Printing, Data Writing to Memory Tags and Data Reading from Memory Tags, and methods therefor

5

Field of the Invention

The invention relates to printing apparatus, and in particular to such apparatus which in addition to printing can write data to memory tags on or in the paper or other base medium being printed onto, and to a method of doing so, and which can read data from memory tags on or in the paper or other base medium.

10

Background of the Invention

Memory tags in the form of Radio Frequency Identification (RFID) tags are well known in the prior art. RFID tags come in many forms but all comprise an integrated circuit on which in use information can be stored and a coil which enables it to be interrogated by a reader which also powers it by means of an inductive (wireless) link. Until recently RFID tags have been quite large, due to the frequency they operate at (13.56MHz) and the size of coil they thus require, and have had very small storage capacities. Such RFID tags have tended to be used in quite simple applications, such as for file tracking within offices or in place of or in addition to bar codes for product identification and supply chain management.

20

Much smaller RFID tags have also been developed, operating at various frequencies. For example Hitachi-Maxell have developed "coil-on-chip" technology in which the coil required for the inductive link is on the chip rather than attached to it. This results in a memory tag in the form of a chip of 2.5mm square, which operates at 13.56MHz. This chip is capable of both being read and being written to. In addition Hitachi has developed a memory tag they

25

call a "mu-chip" which is a chip of 0.4mm square and operates at 2.45GHz. This chip is written with data during the manufacturing process in Read-Only-Memory (ROM), but is small enough to be embedded in paper.

5 The invention provides assistance in making practical use of the developments in RFID technology, and indeed in any other memory tag technologies.

Summary of the Invention

10 According to a first aspect of the present invention there is provided apparatus for data printing and data writing to a memory tag on or in a base medium, the apparatus having a print head for printing onto the base medium, and a memory tag write device for data writing to the memory tags on or in the base medium.

15 Preferably the base medium is moved along a first axis through or past the apparatus.

The print head may be moveable relative to the base medium back and forth along a second axis substantially perpendicular to the first axis.

20 At least a part of the memory tag write device required for communication with the memory tags may also be moveable relative to the base medium back and forth along a third axis also substantially perpendicular to the first axis.

25 The print head and the part of the memory tag write device may conveniently be connected together and move in unison along the second and third axes. Indeed in some embodiments the print head and part of the memory tag write device may be amalgamated into a single unit and the second and third axes coincide.

In the alternative the print head and the part of the memory tag write device may move independently along the second and third axes.

In further alternatives the memory tag write device may be located in a fixed position within the apparatus and the base medium moves past it.

Preferably the memory tag write device is a memory tag read/write device, such that the data written to the memory tags can be read and checked
5 after being written.

However the apparatus may further include a data check device, such that data written to the memory tags by the memory tag write device can be read and checked after being written, in which case the memory write device need not also perform the read and checking function.

10 Preferably the memory tags are RFID tags and the memory tag write device includes an inductive coil for communication therewith.

The apparatus may be adapted to handle base medium in sheet form which passes through the apparatus. This may be sheets of paper or like material.

15 Conveniently the print head uses ink jet technology, but it may use a different technology such as laser printing.

According to a second aspect of the invention there is provided a method of printing onto a base medium and writing to a memory tag on or in the base medium comprising the steps of:

- 20 i) feeding the base medium along a first axis past a print head;
ii) printing onto the base medium;
iii) feeding the base medium past a memory tag write device;
iv) writing data to a memory tag in or on the base medium.

The memory may further include the step of moving the print head
25 relative to the base medium along a second axis substantially perpendicular to the first axis in order to print onto the base medium at the required locations.

The method may further comprise the step of moving the memory tag write device along a third axis substantially perpendicular to the first axis to the location of a memory tag prior to writing data to the memory tag.

The method may also further comprise the step of reading the data on the memory tag and checking it against the data written to it.

Brief Description of the Drawings

5 Embodiments of apparatus according to the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic of the main elements of a first embodiment of apparatus according to the invention from the side;

10 Figure 2 is a schematic of the apparatus of Figure 1 from above;

Figure 3 is a block diagram of the control of the apparatus according to the invention;

Figure 4 is a schematic of the main elements of a second embodiment of apparatus according to the invention from above;

15 Figure 5 is a schematic of the main elements of a third embodiment of apparatus according to the invention from the side;

Figure 6 is a schematic of the main elements of a fourth embodiment of apparatus according to the invention from the side; and

20 Figure 7 is a schematic of a memory tag and read/write device as incorporated in any embodiment of the invention.

Detailed Description of the Preferred Embodiments

Referring to Figures 1 and 2, apparatus 10 for printing onto a base medium and data writing to a memory tag in or on the base medium is
25 illustrated. This embodiment is for use with a base medium in the form of sheet paper 12, to which memory tags 8 have been applied or within which memory tags 8 have been embedded (as shown in Figure 1). The memory tags 8 are RFID memory tags for which the manner of writing data to the tags and reading data from the tags is well known (see for example the RFID Handbook, Klaus

Finkenzeller, 1999, John Wiley & Sons). For simplicity only those parts of the apparatus 10 which need to be shown to describe the invention are illustrated and described. It will be understood that the apparatus 10 includes much known technology from the prior art of printers, and from the prior art of RFID
5 memory tags, which is not described here.

The apparatus 10 includes paper feed rollers 14 which are driven to rotate as indicated by arrows R1 to feed the paper sheets 12 through the apparatus 10 along a first axis in the direction indicated by arrows A1.

The apparatus 10 further includes a print head 16, which in this example
10 is of ink jet form, mounted on a print head carriage 18 which extends across the apparatus 10 substantially perpendicular to the axis A1. The print head 16 is moveable back and forth along the print head carriage 18, in known manner. Thus the print head 16 is moveable back and forth along a second axis indicated by arrows A2, substantially perpendicular to the axis A1, to enable the print
15 head 16 to access most of the upper surface 12a of the paper sheet 12 as it moves through the apparatus 10, and thus to print anywhere on that accessible area of surface 12a as required.

The apparatus 10 also includes a memory tag read/write device 20 which operates in known manner to write data to and/or read data from memory tags
20 as required using an inductive coil 21. The inductive coil 21 of the memory tag read/write device 20 is connected to the print head 16 for movement back and forth along the print head carriage 18 with the print head 16. Thus the inductive coil 21 is moveable back and forth along a third axis indicated by arrows A3, substantially perpendicular to the axis A1, and parallel to the axis A2, to enable
25 the memory tag read/write device 20 to read data from and/or write data to memory tags 8 located anywhere on or in the accessible area of the paper sheet 12, as will be described further below.

Referring now also to Figure 3, the apparatus 10 also includes a main processor 22 and a mechanics controller 26, which controls all the mechanical

operations of the apparatus 10, (i.e. the paper feed rollers 14, the movement of the print head 16 and inductive coil 21 along the print head carriage 18). The main processor 22 receives instruction signals from a host computer 24, including the details of:

- 5 what to print;
- where to print it;
- where the memory tag 8 is or tags 8 are in/on the paper sheet 12; and
- what data to write to the memory tag(s) 8.

The main processor 22 sends command signals as required to:

- 10 the mechanics controller;
- the print head 16; and
- the memory tag read/write device 20,

to implement the instruction signals.

- Thus the paper sheet 12 is fed through the apparatus 10 and has the
- 15 required information printed on it's upper surface 12a. At the same time the
 - memory tags 8 on or within the paper sheet 12 have the necessary data written
 - to them by the memory tag read/write device 20, with the movement of the
 - memory tag read/write device 20 (and print head 16) being paused with the
 - memory tag read/write device 20 over the or each memory tag 8 as necessary
 - 20 for the data writing to take place.

- The manner of co-ordination of the printing and data writing processes will depend on a number of factors. If, for example, the memory tags 8 are only present adjacent the top and/or bottom of the paper sheet 12 then the data writing process can take place before and/or after the printing. This would
- 25 avoid the necessity for the printing process to be interrupted, and would make
 - the co-ordination simpler. Further, when implemented with an inkjet printer,
 - which in general requires a pause, after printing has been completed before the
 - paper sheet is ejected, to allow the ink to dry, the data writing process could

conveniently take place during this pause for memory tags present adjacent the bottom of the paper sheet 12.

It is likely that the memory tags 8 will be read in future both by further apparatus which can scan the paper sheet 12 to locate the memory tags 8 and by
5 hand held readers. Thus in order to assist users in the future to locate the memory tags 8 on the paper sheet 12 the memory tags 8 may have icons printed over their locations which can be readily identified by users.

The memory tag read/write device 20 may, in addition to writing the data to the memory tags 8, also conduct a read operation to check that the data has
10 written successfully before the paper sheet 12 is moved on following the data write operation. Alternatively, particularly if the apparatus 10 is operating at high speed, a separate data check device (not shown) may be included in the apparatus such that this operation takes place downstream of a memory tag write device which in this case need not also be capable of data reading.

15 As the apparatus 10 is capable of both writing data to memory tags 8 in or on a base medium, and reading data from such memory tags 8, it can also be used to read data stored in memory tags 8 in or on previously printed sheets of paper 12. Thus such a sheet of paper 12 may be fed into the apparatus 10 set in "read" mode by the operator, and the contents of the or each memory tag 8 in or
20 on the sheet paper will then be read into a memory portion of the main processor 22 of the apparatus 10. The data may then be passed to the host computer 24. However, the data in the memory tag 8 may, for example, comprise an electronic version of the printed matter on the sheet of paper 12, thus enabling the apparatus 10 to produce one or more copies of that printed
25 matter without the need to scan the printed matter, and hence such copies should be free from the kinds of errors that may be generated by scanning. This may be of particular use where the printed matter is a photograph, which over a period of time may fade, or otherwise deteriorate, such that it cannot be copied adequately by conventional techniques. The data stored in the memory tag 8

would effectively be a digital "negative" enabling fresh copies of the photograph to be produced after an extended period of time.

Furthermore, the data could be sent to the host computer 24, altered in some way, such as editing of a word processed document, or digital
5 manipulation of a photograph, and then the data could be sent back to the apparatus 10 to be printed and stored in another memory tag 8 in it's altered form.

Referring now to Figure 7 the basic operation of the memory tags 8 and of the read/write device 20 will be described. The memory tag 8 includes an
10 antenna coil L1 and a capacitor C1 connected in parallel therewith to form a resonant circuit. It further includes a memory M and processing and power circuit P1. The read/write device 20 includes an antenna coil L2 and a capacitor C2 in parallel therewith to form a resonant circuit, and a processing and signal generating circuit P2.

15 A signal generator with in P2 generates a signal at the chosen frequency, such as 2.45GHz, this is applied to the antenna coil L2 and thus generates an electro-magnetic field which, provided the memory tag 8 is sufficiently close to the read/write device 20, penetrates the antenna coil L1 of the memory tag 8. By induction a voltage is thus generated in the antenna coil L1, this is rectified
20 in circuit P1 and used to power the memory tag 8. The capacitance of the capacitors C1 and C2 is selected such that the resonant circuits are both resonant at the frequency generated by the signal generator, in order to maximise transmitted signal strength and received signal.

When data is to be written to the memory tag 8 by the read/write device
25 20 the radio frequency signal generated in P2 is modulated, e.g. amplitude modulated, with the data before being applied to the antenna coil L2 and transmitted. The signal received by the memory tag 8 by inductive coupling thus both powers the memory tag 8 and communicates with it, the circuit P1

separating the data signal from the carrier and passing data for storage to the memory M.

Similarly, if data is to be read from the memory tag 8 the circuit P1 applies a signal indicative of the data to the antenna coil L1 which is detected,
5 as a result of the inductive coupling, by antenna coil L2 and deciphered in circuit P2 before being passed from the read/write device 20 to main processor 22 of the apparatus 10. This signal may for example be transmitted using load modulation. In RFID systems such as this the power consumed by the memory tag 8 can be measured as a drop in voltage across the internal resistance of the
10 antenna coil L2 of the read/write device 20. A load resistance within the circuit P1 may be switched on and off, thus altering the power consumed by the memory tag 8 which is then detected as an amplitude modulation of the voltage across the antenna coil L2 of the read/write device 20.

Although the print head 16 is described as being of ink jet form, the
15 invention can be implemented with many different forms of print head and indeed many different forms of printer. For some forms of printer it may be appropriate for the memory tag read/write device 20 to be moveable independently of the print head 16, as shown in Figure 4, rather than these units being connected together for movement as one or indeed amalgamated into a
20 single unit. In this alternative embodiment of apparatus 10' the memory tag read/write device 20 is mounted on a read/write device carriage 30 for independent movement along the axis A3. The read/write device carriage 30 is shown downstream of the print head carriage 18, but could alternatively be located upstream of it, such that the data read/write to the memory tag(s) 8
25 takes place ahead of the printing onto the base medium. Such embodiments still fall within the scope of this invention.

For the apparatus 10 in which the print head 16 and memory tag read/write device move in unison, a practical embodiment would incorporate the inductive coil 21 into the print head 16, with the control circuits located

within a fixed portion of the apparatus 10. In such embodiments the axes A2 and A3 will be coincident

Further alternative embodiments also fall within the scope of the invention. For example, apparatus 10'' shown in Figure 5 (in which parts
5 common with the previous embodiments are again like referenced) has an inductive coil 21' of the memory tag read/write device 20 located in a bed 15 of the apparatus 10'' rather than being moveable. This means that the apparatus 10'' is only for use with base media which have the memory tags 8 located in or on them in such a way that the memory tags 8 will pass over the inductive coil
10 21' whilst passing through or past the apparatus 10''. For example if the base medium is paper sheets 12 the memory tags 8 may all be embedded in a particular line down one side of the paper sheets 12. Similarly, if the base medium is packaging of some kind the memory tags 8 may all be located adjacent a particular corner thereof.

15 In a further alternative embodiment of apparatus 10''', shown in Figure 6, a memory write device 21a is located in the bed 15 of the apparatus 10''', with a separate data check device 21b being provided, also in the bed 15 of the apparatus 10''' located downstream of the memory write device 20a. In embodiments where the memory tags 8 are limited as to their location in the
20 base media this option may be particularly appropriate.

The embodiments of apparatus 10, 10; 10'' and 10''' have been described as appropriate for use with paper sheets 12. However, embodiments of the invention may also be constructed for use with other base media, for example paper in fan fold or roll form, other sheet materials, or indeed boxes or
25 other packages passing underneath, rather than through, the apparatus according to the invention on some kind of conveyor.

All of the above described embodiments of apparatus 10, 10; 10'' and 10''' have included print heads which are moveable relative to the base medium, such as for example in inkjet printers. However, the invention may

also be implemented with other forms of printing technology, such as laser printers, in which the print heads are fixed within the apparatus and do not move relative to the base medium or other wise.

The invention is described in use with RFID memory tags, but apparatus
5 according to the invention may be constructed for use with other forms of memory tag which operate at other frequencies, outside the radio frequency range.

The apparatus of the invention provides a significant advantage over the prior art in that data can be written to one or more memory tags on a base
10 medium, at the same time that data is printed onto the base medium. This enables much more rapid production of documents etc. with data in both visible and electronic form stored on them.

CLAIMS

1. Apparatus for data printing and data writing to a memory tag on or in a base medium, the apparatus having a print head for printing onto the base medium, and a memory tag write device for data writing to the memory tags on or in the base medium.
2. Apparatus according to claim 1 wherein the base medium is moved along a first axis through or past the apparatus.
3. Apparatus according to claim 2 wherein the print head is moveable relative to the base medium and moves back and forth along a second axis substantially perpendicular to the first axis.
4. Apparatus according to claim 2 or 3 wherein at least a part of the memory tag write device required for communication with the memory tags is moveable relative to the base medium back and forth along a third axis substantially perpendicular to the first axis.
5. Apparatus according to claim 4 as dependent on claim 3 wherein the print head and the part of the memory tag write device are connected together and move in unison along the second and third axes.
6. Apparatus according to claim 5 wherein the print head and the part of the memory tag write device are amalgamated into a single unit and the second and third axes coincide.

7. Apparatus according to claim 4 as dependent on claim 3 wherein the print head and the part of the memory tag write device move independently along the second and third axes.
- 5 8. Apparatus according to claim 1, 2 or 3 wherein the memory tag write device is located in a fixed position within the apparatus and the base medium moves past it.
9. Apparatus according to any one of the preceding claims wherein the
10 memory tag write device is a memory tag read/write device, such that the data written to the memory tags can be read and checked after being written.
10. Apparatus according to any one of claims 1 to 8 wherein it further
15 includes a data check device, such that data written to the memory tags by the memory tag write device can be read and checked after being written.
11. Apparatus according to any one of claims 1 to 8 wherein the memory tag
20 write device is a memory tag read/write device, such that data written to memory tags on previously printed base medium can be read from those memory tags when the previously printed base medium is moved through or past the apparatus.
- 25 12. Apparatus according to claim 11 wherein the data once read is used to print additional copies of the previously printed base medium.

13. Apparatus according to any one of the preceding claims wherein the memory tags are RFID tags and the memory tag write device includes an inductive coil for wireless communication therewith.
- 5 14. Apparatus according to any one of the preceding claims wherein it is adapted to handle base medium in sheet form which passes through the apparatus.
- 10 15. Apparatus according to claim 14 wherein it is adapted to handle sheets of paper or like material.
16. Apparatus according to any one of the preceding claims wherein the print head uses ink jet technology.
- 15 17. A method of printing onto a base medium and writing to a memory tag on or in the base medium comprising the steps of:
- i) feeding the base medium along a first axis past a print head;
 - ii) printing onto the base medium;
 - iii) feeding the base medium past a memory tag write device;
 - 20 iv) writing data to a memory tag in or on the base medium.
18. A method according to claim 17 wherein it further includes the step of moving the print head relative to the base medium along a second axis substantially perpendicular to the first axis in order to print onto the base medium in the required locations.
- 25 19. A method according to claim 17 or 18 wherein it further comprises the step of moving the memory tag write device along a third axis

substantially perpendicular to the first axis to the location of a memory tag prior to writing data to the memory tag.

20. A method according to any one of claims 17 to 19 wherein it further
5 comprises the step of reading the data on the memory tag and checking it against the data written to it.
21. Apparatus for data printing, data writing to a memory tag on or in a base
10 medium, and data reading from a memory tag on or in the base medium, the apparatus having a print head for printing onto the base medium, and a memory tag read/write device for data writing to or data writing from the memory tags on or in the base medium.
22. A method of printing onto a base medium comprising the steps of:
15 i) feeding a previously printed base medium including a memory tag with data stored therein concerning the printed matter along a first axis past a memory tag read device;
ii) reading the data from the memory tag;
iii) feeding the base medium past a print head;
20 iv) printing onto the base medium using the data read from the memory tag.
23. Apparatus substantially as hereinbefore described with reference to
25 Figures 1, 2, 3 & 7, or 3, 4 & 7, or 3, 5 & 7 or 3, 6 & 7 of the accompanying drawings
24. A method substantially as hereinbefore described with reference to the accompanying drawings.

ABSTRACT

Title: Apparatus for Printing, Data Writing to Memory Tags, Data Reading
5 from Memory Tags, and methods therefor

Apparatus (10) for data printing and data writing to a memory tag (8) on
or in a base medium (12) is described. The apparatus (10) includes a print head
(16) for printing onto the base medium (12), and a memory tag write device
10 (20) for data writing to the memory tags (8) on or in the base medium (12).
Preferably the base medium (12) is moved along a first axis (A1) through or
past the apparatus (10). The print head (16) may be moveable relative to the
base medium (12) such that it moves back and forth along a second axis (A2)
substantially perpendicular to the first axis (A1), depending on the printing
15 technology concerned. Generally at least a part (21) of the memory tag write
device (20) required for communication with the memory tags (8) is moveable
relative to the base medium (12) back and forth along a third axis (A3)
substantially perpendicular to the first axis (A1).

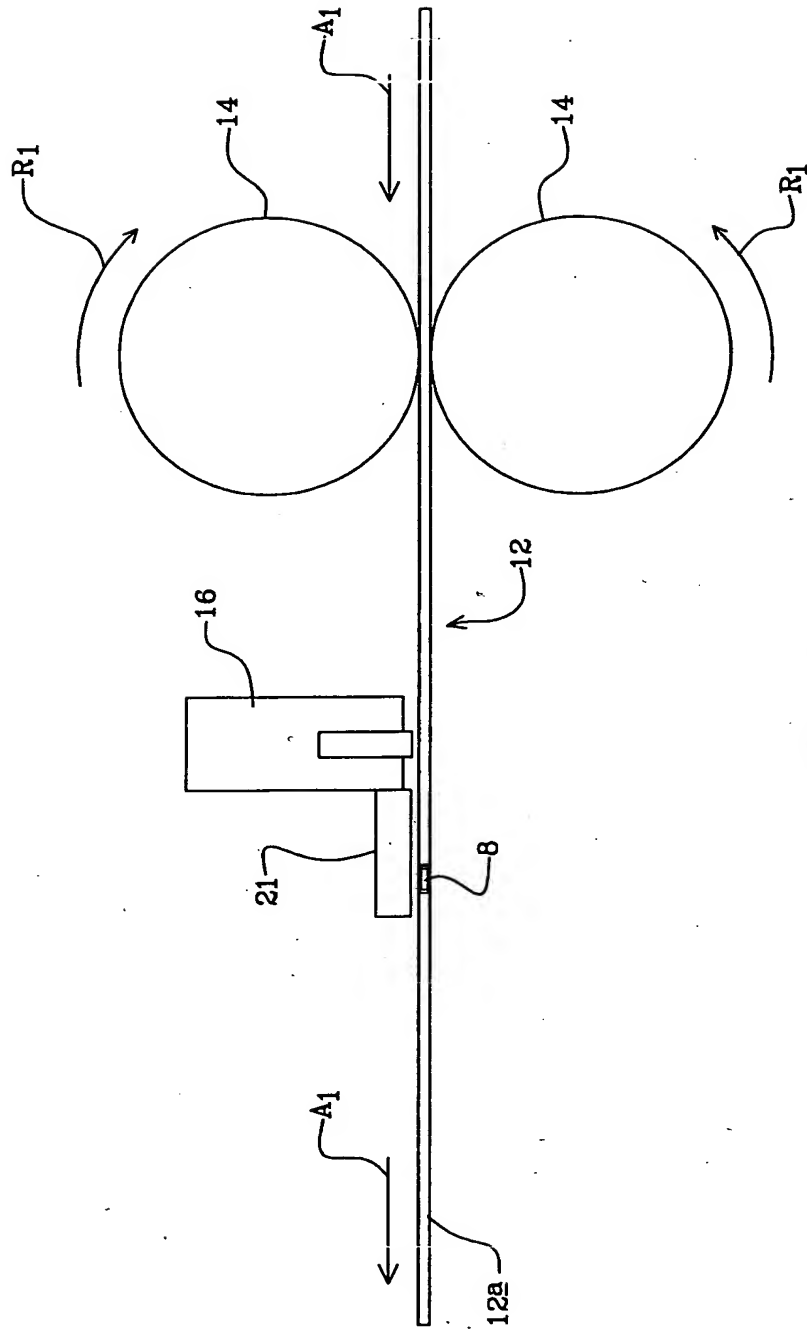


FIG 1

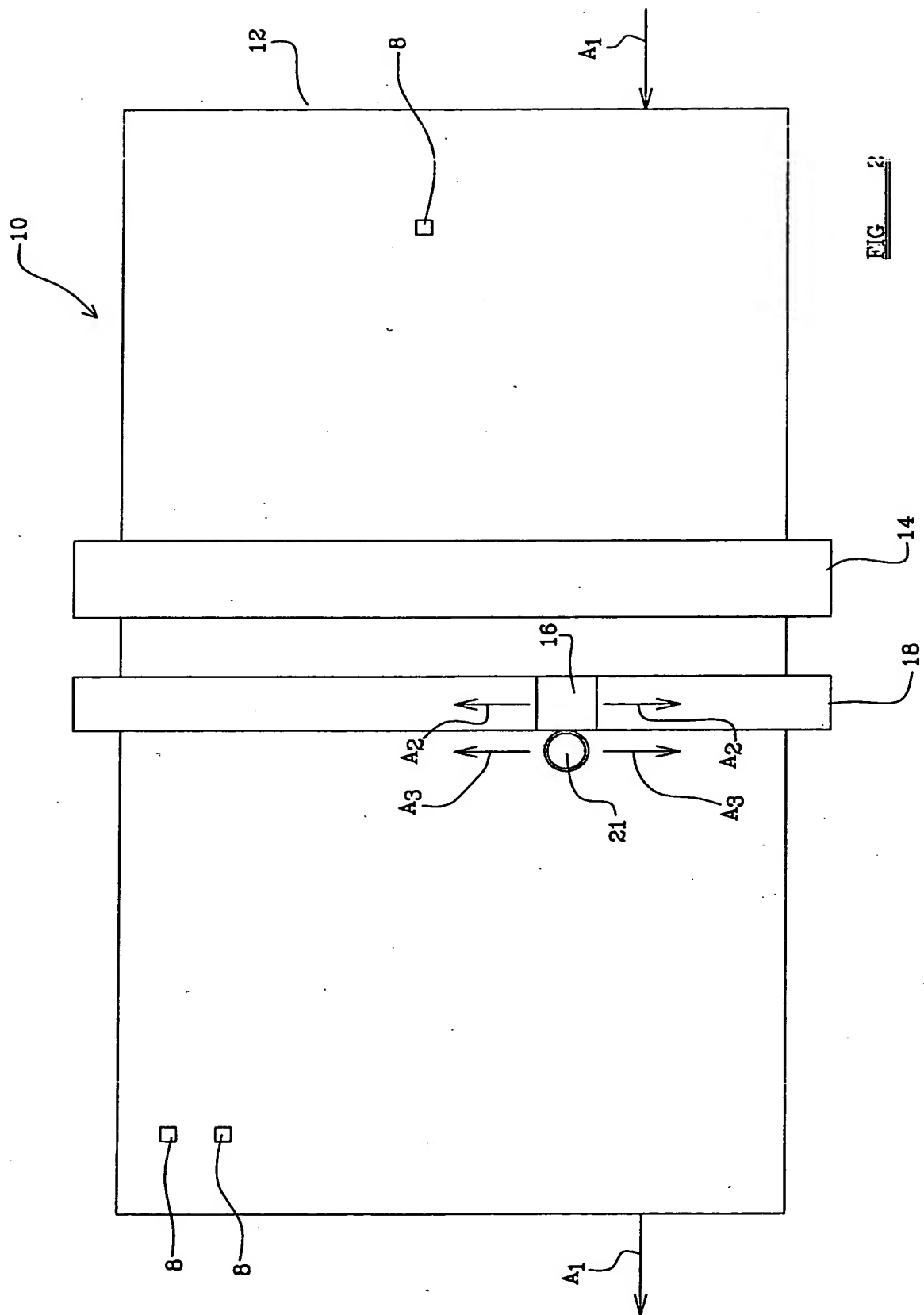


FIG. 2

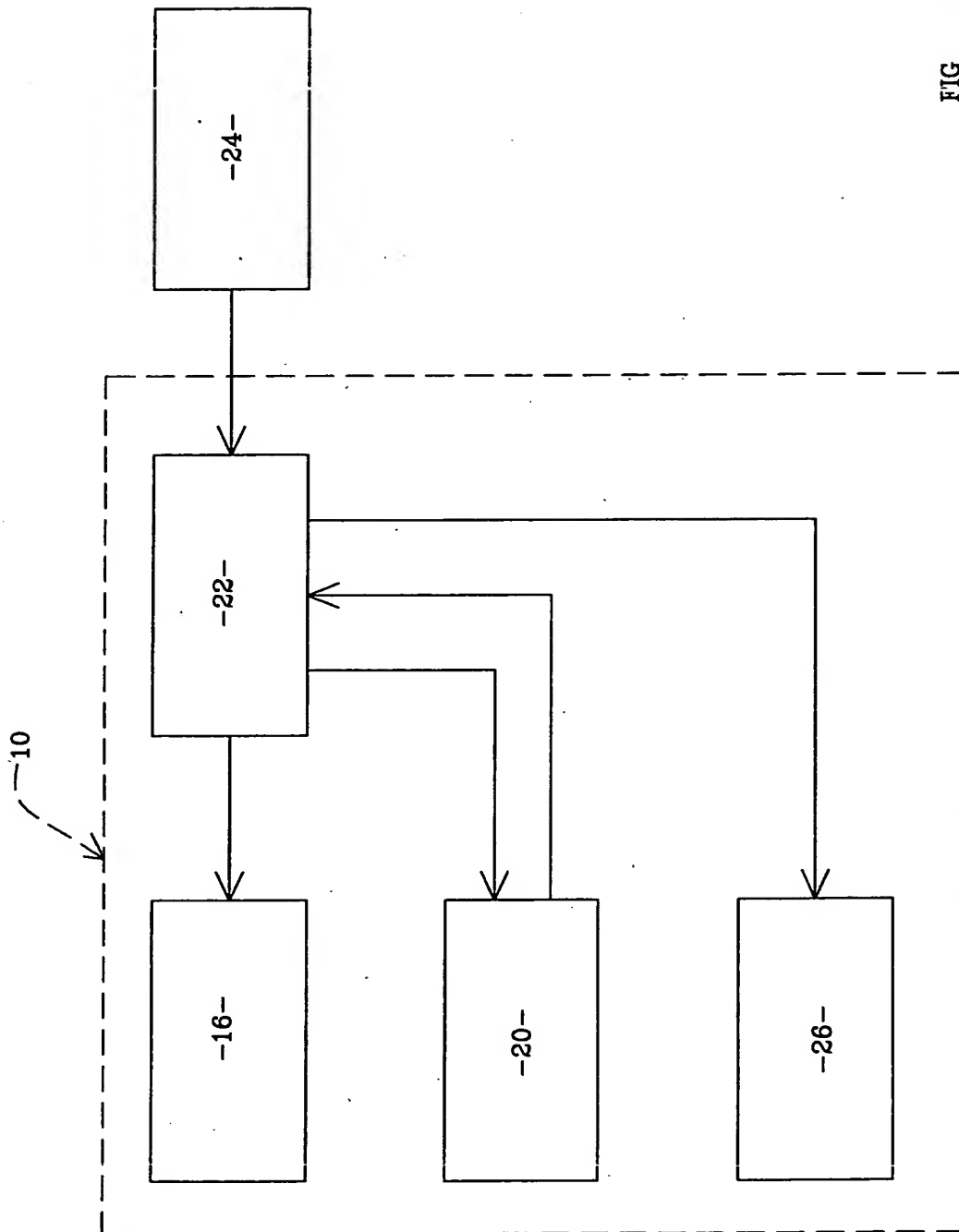
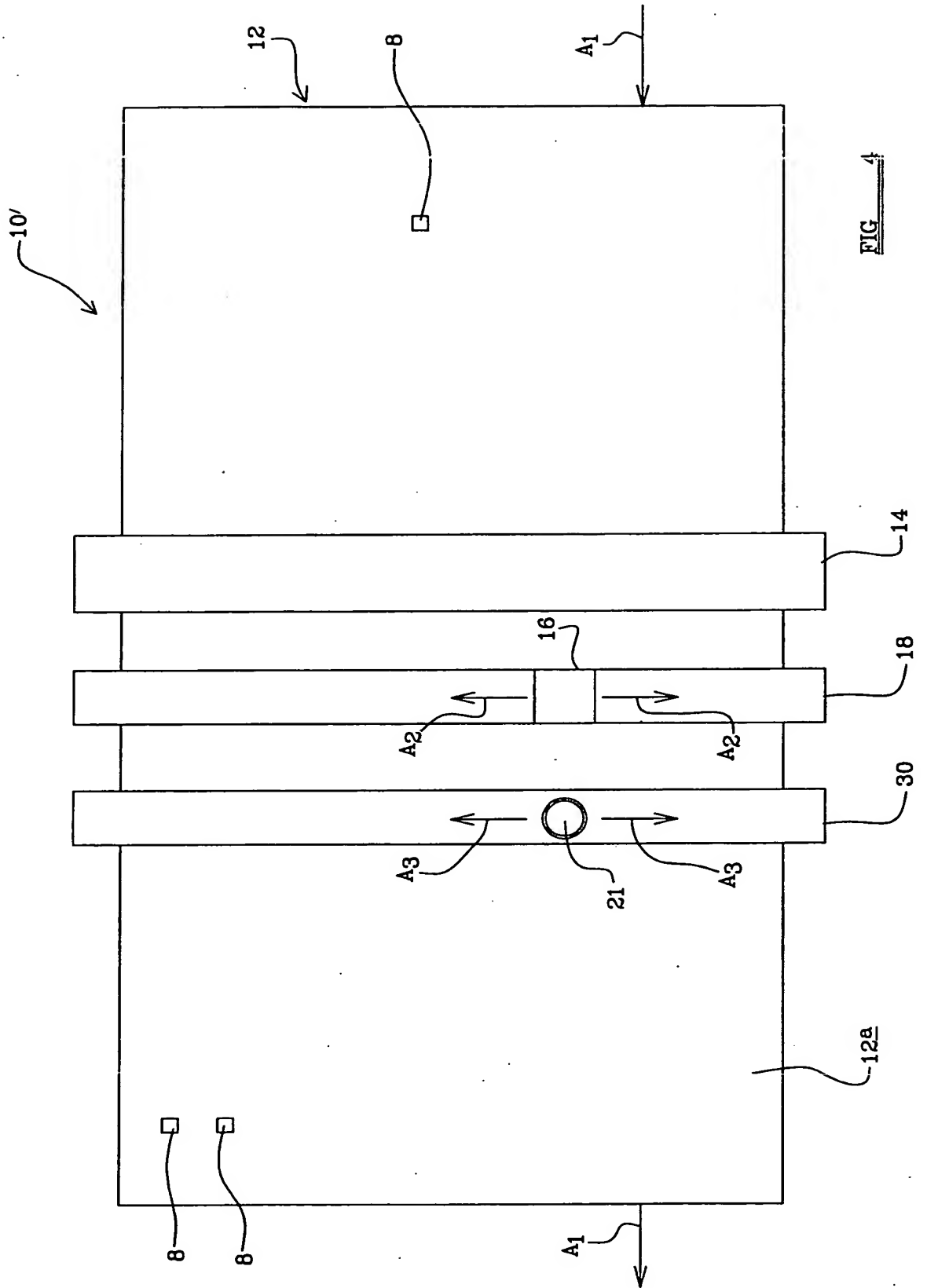


FIG 3



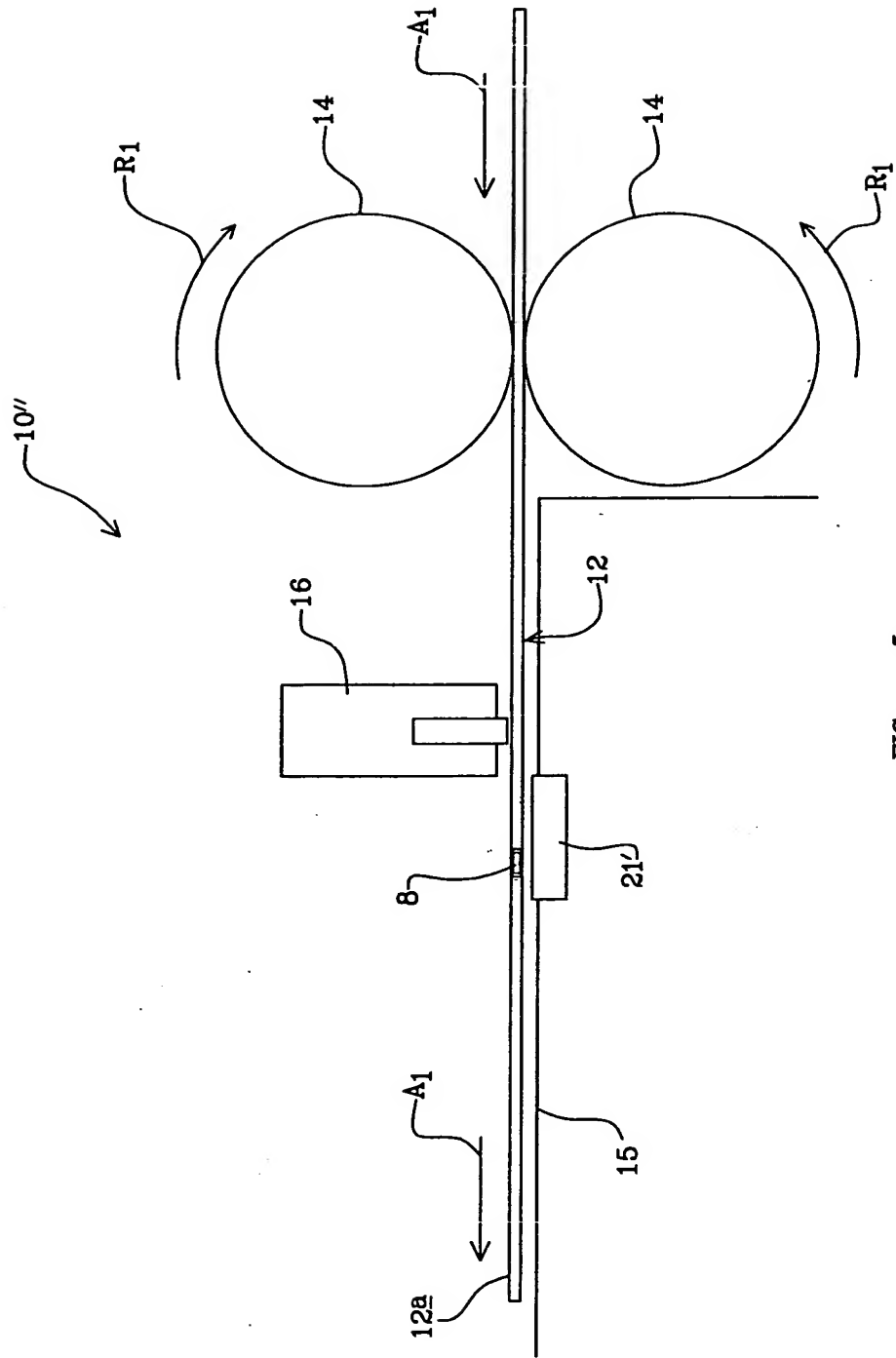


FIG 5



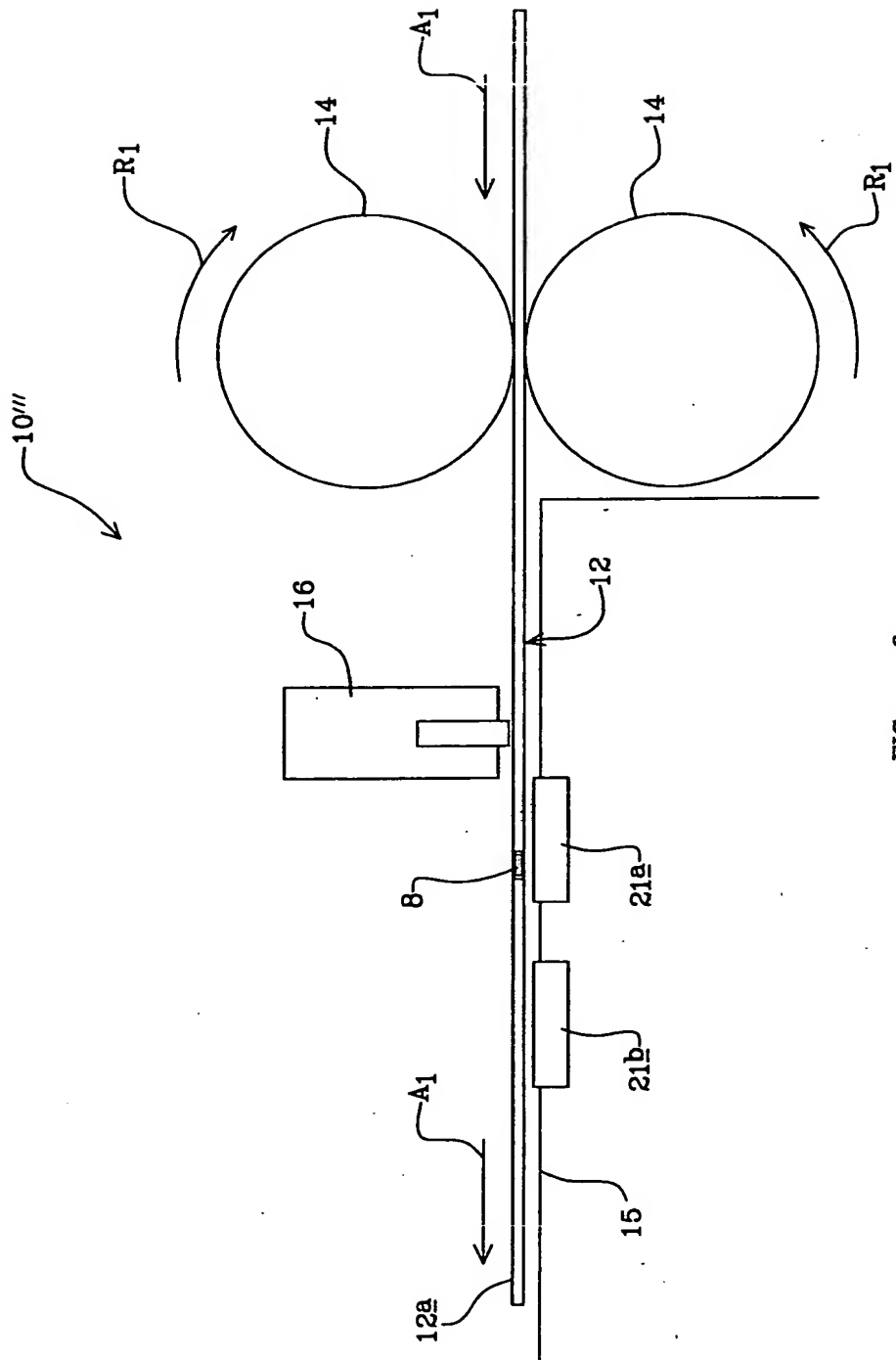


FIG 6



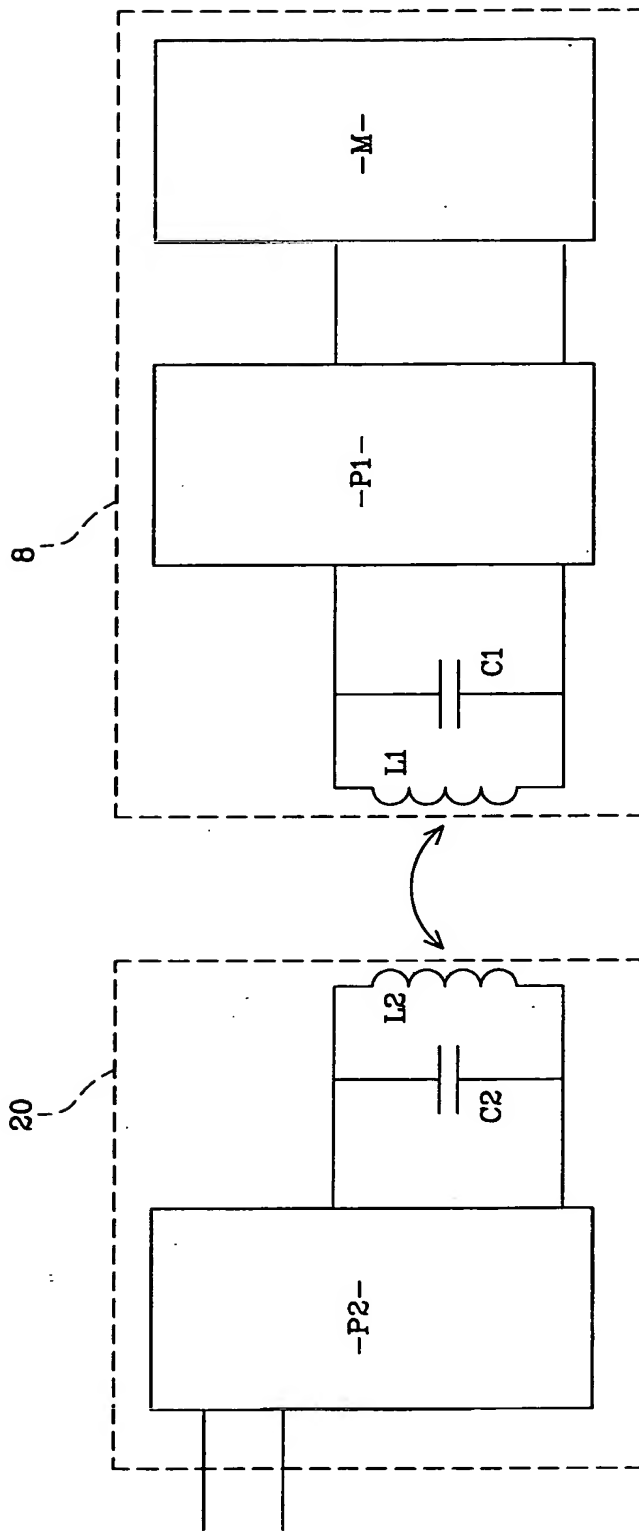


FIG 7

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